REMARKS

Status of the Application

Claims 1-36 remain pending in the application. Applicant has amended the specification to include a reference to color drawings, but the claims have not been amended. However, to facilitate the Examiner's consideration of the following remarks, applicant has above included a listing of the claims.

Objection to the Drawings

The application as filed contains color images. The Examiner notes that an appropriate petition must be filed, as required under 37 CFR § 1.84(a)(2), to permit color photographs or color drawings to be used as acceptable drawings in a patent or application. Accordingly, applicant encloses herewith a petition to accept the color drawings in the present application. Enclosed with the petition is the required fee and three copies of the drawings – including the color images. Applicant has amended the specification so that under the "Brief Description of the Drawings," the required reference is made to the color drawings and therefore requests that the Examiner withdraw the objection to the drawings.

Claims Rejected under 35 U.S.C. § 102(a)

The Examiner has rejected Claims 1-36 as being anticipated by Blanz et al., "A Morphical Model for the Synthesis of 3D Faces," ACM, 1993, Pages 279-288. In regard to the rejection of Claim 1, the Examiner indicates that the reference discloses each of the steps of Claim 1. Applicant respectfully disagrees with this conclusion and the rejection of the other claims over Blanz.

Applicant is hard pressed to understand the Examiner's basis for rejecting any of the claims in the present application as being anticipated by Blanz, which is directed to an entirely different concept having virtually nothing to do with the present claimed invention. To enable the Examiner to better understand the distinct differences between Blanz and each of the claims in the present invention, it may be helpful to initially discuss the invention disclosed by Blanz. As indicated by the Abstract on page 187 and as illustrated by the process shown in Figure 4, Blanz teaches a process for reconstructing a three-dimensional shape and a texture for a new face from a single image of a face, for example, an image input using a single photograph. Blanz makes use of a 3D database produced by laser scanning the heads of 200 young adults, including equal numbers of male and female subjects. The laser scan provides head structure data in a cylindrical representation, as explained

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under the section of Blanz entitled "Database," on page 188 of the reference. These faces were processed and represented by approximately 70,000 vertices and by about the same number of color values in the database. Blanz teaches that a morphable model is then determined, based upon the data set derived from the 3D faces that were scanned. The morphable face model is constructed using shape and texture data expressed in barycentric coordinates. Additional steps are used in processing the data to produce the morphable 3D face model. Under the section entitled "Abstract," Blanz teaches that "3D faces can either be generated automatically from one or more photographs, or modeled directly through an intuitive user interface."

When a 2D photo image is input, the morphable model is initialized and interactively aligned roughly with a 3D average of the morphable model data. An automated matching procedure fits the 3D morphable model to the photographic image using a complex procedure that is described under the topic "Matching a Morphable Model to Images," on page 190 through most of page 191 of Blanz. Next, details and texture of the morphable model are improved by using an illumination-correcting texture extraction from the input image. In this step, a texture is extracted from the photograph that was input, and the extracted texture is applied to the 3D model resulting from the previous step.

Several points of distinction between the present claimed invention and the process taught by Blanz are readily apparent from the preceding discussion of Blanz. First, Blanz is clearly not directed to "a method for simulating a real-time rendering of a desired graphical effect in an image of an object on a display, in regard to a single static viewpoint," as recited by the preamble of applicant's Claim 1. Instead, Blanz is directed to automatically modeling a textured 3D face from one or more photographs, or by using input provided by a user interface. Applicant developed a technique to minimize processing resources required when producing a simulated real-time rendering of a graphical effect in an image of an object. In contrast, Blanz produces a true three-dimensional model corresponding to a two-dimensional input (i.e., a photograph) provided by a user. Therefore, it is apparent that Blanz and the present claimed invention are directed to performing entirely different functions that have no similarity to each other.

In subparagraph (a) of Claim 1, applicant recites the step of "precomputing data defining a behavior of light rays illuminating the object in regard to the single static viewpoint, based on a plurality of input images, to produce a plurality of morph maps for the object in which at least one set of pixel-dependent data is associated with each pixel position on the display." There is nothing

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disclosed by Blanz that is equivalent to this step, and the Examiner has failed to cite to any portion of Blanz that is equivalent to this step. The compilation of the data set corresponding to using a laser to scan 200 faces does not in any way correspond to precomputing data defining a behavior of light rays illuminating an object. In fact, a three-dimensional laser scan provides empirical scan data rather than computed data and the data are 3D data and are the result of actually using laser light to scan 3D objects, i.e., the faces of the 200 subjects. Accordingly, Blanz does not teach or suggest step (a) in Claim 1.

In regard to step (b) of Claim 1, which recites "in response to one of a user action and an event that indicates the desired graphical effect, performing a transformation two-dimensionally using the plurality of morph maps to produce an output image that simulates the real-time rendering of the desired graphical effect," the Examiner indicates that "Blanz discloses a set of facial expressions expressed two dimensional for morphing, i.e., transformation," and cites to page 189, section 3.1 and Figure 4 on page 190 of the reference. However, this portion of Blanz simply states that "facial expressions can be transferred by recording two scans [i.e., two scans with a laser] of the same individual with different expressions, and adding the differences...to a different individual in a neutral expression." This section of Blanz therefore does not teach that a transformation is done two-dimensionally using a plurality of morph maps to produce an output image that simulates the real-time rendering of a desired graphical effect, as recited in Claim 1. It must be emphasized that each of the illustrations shown in Figure 3 of Blanz are produced by adding or subtracting shape and texture vectors specific to a particular attribute, to a three-dimensional model. Accordingly, Blanz does not teach or suggest a transformation "two dimensionally" to achieve the facial expressions illustrated. Similarly, in regard to Figure 4 of Blanz, a texture extracted from a two dimensional input photograph and applied to a three dimensional surface of the morphable model is not a transformation made two dimensionally using a plurality of morph maps. Thus, contrary to the Examiner's assertion, Blanz does not disclose step (b) of Claim 1. Furthermore, because Blanz uses a three-dimensional model, the model can be displayed from a plurality of different viewpoints, as indicated by the views in Figure 3. It should also be noted that the input shown in Figure 4 is a two-dimensional photograph, and the technique disclosed by Blanz teaches how to reconstruct a three-dimensional shape and texture corresponding to that of the two-dimensional input photographic image using the data set, so that what is rendered on the display is indeed a true three-dimensional

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model derived from scan data, and not a simulated three-dimensional rendering of an effect on an object. Therefore, it should be clear that Blanz does not teach or suggest the invention as recited by applicant in Claim 1.

In rejecting Claim 2, the Examiner states that "Blanz discloses blending the borders of the image data according to an algorithm proposed for images" and refers to page 189, section 3 of the reference. However, Claim 2 recites "the step of precomputing comprises the step of producing data that include a blending factor." In reviewing the portion cited to by the Examiner, it is apparent that it refers to an entirely different type of blending. Specifically, Blanz teaches "a complete 3D face is generated by computing linear combinations for each segment separately and blending them at the borders according to an algorithm proposed for images by [7]." Therefore, Blanz is not disclosing a blending factor, as recited by applicant's claim, but is instead referring to blending the segments comprising a morphable model at the borders between each segment, probably so that they do not appear as separate regions. There is no mention of including "a blending factor" in data, by Blanz. Thus, Blanz does not teach or suggest the subject matter of Claim 2.

In Claim 3, applicant recites that "the step of precomputing comprises the step of producing data that include an additive factor that is used to control saturation of the output image." In contrast, Blanz teaches that "the appearance of an original face can be changed by adding or subtracting shape and texture vectors specific to the attribute." In this case, the attribute is a particular facial expression, and there is no teaching or suggestion by Blanz that an additive factor might be used to control the saturation of an output image. Therefore, Blanz does not teach or suggest the subject matter of Claim 3.

Claim 4 recites that the step of precomputing "comprises the step of tracing rays of light to determine the plurality of morph maps based on a global illumination and a local illumination at each intersection of the rays of light with a surface." In contrast, Blanz teaches producing a morphable model selected to match a two-dimensional input image (i.e., the photograph). Blanz allows parameters such as those suggested by the Examiner to be specified. However, these parameters are not specified for the purpose of precomputing a plurality of morph maps, as recited by applicant in Claim 4. There is no equivalent relationship between the teaching of Blanz and what is recited in this claim. Claim 4 is thus patentable, since it recites novel and non-obvious subject matter.

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In Claim 5, applicant provides that the step of performing the transformation includes the steps of "producing a plurality of warped images from the plurality of morph maps," and "combining the plurality of warped images over a range, with a cross-dissolve, to produce successive output images in which the object morphs between an initial state and a final state." In contrast, the Examiner simply cites to Figure 8 in Blanz, which discusses using warping to generate new orientations while retaining details of a painting. Blanz fails to teach or suggest any of the details as recited in Claim 5. Specifically, Blanz fails to teach combining a plurality of warped images over a range with a cross-dissolve. The Examiner has chosen to ignore these details in making this rejection, and it should be withdrawn.

Claim 6 recites that "the step of performing the transformation comprises the step of mapping a selected portion of a surface of the object onto a different part of the object to simulate an effect corresponding to movement of the selected portion of the surface over the object." In contrast, the Examiner cites to section 1, on page 187 of Blanz and indicates that "Blanz discloses performing morphing for motion-captured data to pictures or 3D face models." However, this portion of Blanz actually teaches "the correspondence problem is crucial for all morphing techniques, both for the application of motion-captured data to pictures or 3D face models, and for most 3D face reconstruction techniques from images." Therefore, Blanz does not teach or suggest mapping a selected portion of a surface of an object onto a different part of the object to simulate an effect corresponding to movement of the selected portion of the surface over the object. There is simply no relationship between the portion of Blanz to which the Examiner cites and this aspect of applicant's claimed invention. Accordingly, Claim 6 is clearly patentable.

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Claim 7 recites that "only pixels of the object that have been altered during the transformation to implement the effect are recomputed in the output image." The Examiner cites to a section of Blanz, which states "we describe a method for mapping facial attributes, defined by a hand-labeled set of example faces, to the parameter space of our morphable model. At each position and face space (that is for any possible face), we define shape and texture vectors that, when added to or subtracted from a face, will manipulate a specific attribute while keeping all other attributes as constant as possible." Thus, Blanz does not teach what applicant has claimed. The concept disclosed by Blanz is totally different than recomputing pixels of an object that have been altered during a transformation, while leaving the other pixels the same as they were prior to the recomputation. Therefore, Claim 7 also recites patentable subject matter.

In Claim 8, applicant recites that the step of performing the transformation includes the steps of "providing a grid of cells that overlies and bounds pixels in the selected portion of the surface of the object in the output image," and "for each cell of the grid, associating an arbitrary rectangle having an area that bounds all samples in an original image affected by the pixels in the cell of the output image," and further "determining a union of all rectangles that are associated with the cells of the grid that intersect the area of the arbitrary rectangle, to produce the output image." It will be apparent that there are a number of details in the steps recited in Claim 8. In contrast, the Examiner cites to page 189, section 3 of Blanz and simply indicates that "Blanz discloses a segmented morphable model." However, a segmented morphable model is not the same in any regard to the three steps recited in Claim 8. Accordingly, the Examiner's rejection of Claim 8 should be withdrawn.

Claim 9, which depends on Claim 8, recites the step of "using an index to map between a region in an input image and a corresponding region in the output image, to determine which portion of one of the input image and the output image is changed if a portion of the other of the input image and the output image has changed." In rejecting Claim 9, the Examiner cites to page 189, section 3 and indicates that "Blanz discloses increasing the expressiveness of the model by dividing the face into subregions which are morphed independently to define the regions on a reference face." Clearly, that aspect of Blanz is not in any way related to what is recited in Claim 9 and therefore cannot serve as a basis for rejecting the claim. The Examiner should therefore withdraw the rejection of Claim 9.

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Claim 10 provides that the transformation to achieve the desired effect comprises one of "mapping a texture onto the object in the output image," "applying a reflection to the object in the output image," or "applying a refraction of the object in the output image." In his rejection of this claim, the Examiner cites to pages 190-191, section 4 of Blanz and indicates that "Blanz discloses morphing the image using model parameters such as intensity of ambient light and the intensity of directed light, and further using Phong elimination which takes in account the direction of the reflected ray." While the Examiner is correct in saying that Blanz discloses these points, it is not clear how they have any relevance to mapping a texture onto the object in an output image, or applying a reflection to the object, or applying a refraction of the object in the output image. Clearly, the direction of light illuminating a model and a true rendering has very little to do with these three steps recited by applicant. Thus, the Examiner has improperly rejected Claim 10, and this rejection should be withdrawn.

Claim 11 indicates that the step of precomputing "includes the step of storing anti-aliasing data for use in producing the output image." The Examiner cites to page 192, section 5.1 of Blanz, which "discloses an optic flow to generate a smooth interpolation of the vectors coupled with their neighbors, therefore providing an algorithm to the user for anti-aliasing the image." However, having reviewed this portion of Blanz, it is apparent that Blanz does not suggest that the optic flow algorithm is in any way equivalent to anti-aliasing. Anti-aliasing is a term well known to those of ordinary skill in the graphic arts, and the technique disclosed by Blanz is clearly not equivalent to anti-aliasing as recited in this claim. Therefore, the claim recites patentable subject matter.

Claim 12 recites that the step of precomputing "is based on one of a three-dimensional geometry of the input images and a set of properties of a material in the input images." In rejecting this claim, the Examiner cites to page 189, Figure 2 and indicates that "Blanz discloses morphing based upon shape and texture." While the morph model in Blanz is indeed defined in regard to shape and texture, the morph model is not produced in regard to precomputing where the three-dimensional geometry of the input images or set of properties of a material in the input images determines the result. Recall that Blanz provides for an input of a photograph, which is a two-dimensional image and which does not have any three-dimensional geometry. Also, a property of the material in a photograph is not employed by Blanz for any purpose. Therefore, Blanz does not teach or suggest the aspect of the present invention recited in Claim 12, and the rejection should be withdrawn.

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Claim 13 recites that the data "produced in the step of precomputing include a lookup table in which parameters used in producing the output image are stored." The Examiner indicates that "Blanz discloses the use of a database to store the data, section 2, page 188, therefore making it inherent that the data could be stored in other storage means such as a lookup table." However, the data stored by Blanz is a set of vectors, which do not correspond to parameters used in producing an output image, as recited by applicant. Therefore, the data referenced by Blanz and the lookup table recited in Claim 13 are for entirely different purposes and for use in connection with very different types of data. Accordingly, it would NOT be apparent to one of ordinary skill in the art to use a lookup table in connection with the data stored by Blanz. Claim 13 also recites a novel aspect of the present invention.

The Examiner rejects dependent Claims 14 and 15 based on rationale similar to that used in rejecting independent Claim 1. Accordingly, applicant's traversal of the rejection of Claim 1 is also applicable to Claims 14 and 15. Based on the remarks made in connection with the patentability of Claim 1, it will be apparent that Claims 14 and 15 also recite a patentable invention.

In rejecting Claims 16-36, the Examiner generally applies the same arguments used in justifying the rejection as set forth above in connection with Claims 1-13. Accordingly, applicant's traversal of the rejection of Claims 1-13 is also equally applicable to Claims 16-36. In particular, applicant emphasizes that Claims 16 and 24 are patentable for the same reasons as Claim 1. It should also be noted that each of the dependent claims are patentable for at least the same reasons as the independent claims. Thus, each of the claims that are ultimately dependent upon these independent claims are patentable for at least the same reasons as the independent claims.

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Based upon the preceding remarks, it is clear that all of the claims in the present application define novel and non-obvious subject matter in view of the prior art cited. Therefore, the Examiner is requested to pass the present application to issue at the earliest possible date. Should any questions remain, the Examiner is invited to telephone applicant's attorney at the telephone number listed below.

Respectfully submitted,

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I hereby certify that this correspondence is being deposited with the U.S. Postal Service in a sealed envelope as first class mail with postage thereon fully prepaid addressed to: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450, on October 14, 2003.

Kathy Pankiw

Date: October 14, 2003

RMA:klp

Enclosure
Petition to accept color drawings

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